

SELF SECURITY ALERT SYSTEM USING WIRELESS SENSOR NETWORK

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Abstract: Security is the most important in day to day life for almost all the sectors of the world. The development of self security alert system using wireless sensor network is presented in this project. The main aim of this project is to secure a person under risk by automatic alert system using Peripheral Interface Controller, mobile communication and Force Sensing Resistor. Force Sensing Resistor at the bottom of the foot senses the force being applied. The analog information from this resistor will be converted into digital for further processing by the Microcontroller series. Whenever a person is in distress, he/she has to hit the sandal forcibly on the ground to activate the control unit. When the applied force exceeds the threshold level, the signal will be transmitted to the Radio Frequency Transceiver through Serial Peripheral interface. When Radio Frequency Transceiver receives the signal, it is given to the Microcontroller. Global Positioning System is the receiver that collects data from the satellite and feeds the exact location in the form of latitude and longitude to the user's mobile. Communication is possible by sending a text message in the predefined format to the GSM modem. The main concept in this design is introducing the mobile communication into an embedded system for the purpose of security. The design unit is very simple and low cost.

Keywords: Global Positioning System (GPS), Global System for Mobile Communication (GSM), Force Sensing Resistor (FSR), and Peripheral Interface Controller (PIC).

I. INTRODUCTION

Embedded systems are designed to do some specific task, rather than be a general purpose computer for multiple tasks. Embedded systems are often required to provide Real-Time response. A Real-Time system is defined as a system whose correctness depends on the timeliness of its response. Examples of such systems are flight control systems of an aircraft, sensor systems in nuclear reactors and power plants.

Wireless communication has become an important feature for commercial products and a popular research topic within the last ten years. Technology advancements are providing smaller and more cost effective devices for integrating computational processing, wireless communication, and a host of other functionalities. These embedded communications devices will be integrated into applications ranging from home security to industry automation and monitoring. They will also enable custom tailored engineering solutions, creating a revolutionary way of disseminating and processing information. Engineers who have knowledge of embedded systems and wireless communications will be in high demand. Unfortunately, there are few adorable environments available for development and classroom use, so students often do learn about these technologies during hands-on lab exercises.

In this paper we prescribe a simple cost effective technique of alert system using GSM, GPS and FSR. Human security means protecting people from threats. Security means protecting people from critical and pervasive threats and situations, building on their strengths and aspirations. Prevention and protection is thus a major aspect of our work, in line with the fundamental idea of Human Security.

A. Existing System

I. Home Security Using Zigbee Technology: Security is most essential for houses and it is made possible by integrating various sensors with Zigbee network.

II. A Wireless Sensor Network for Weather and Disaster Alarm Systems: Employed technology is Zigbee. Communication range is of only 300 to 500 meters.

III. Real Time Vehicle Locking and Tracking System using GSM and GPS Technology-An Anti Theft System: This project deals with the design and development of a theft control system for an automobile, which is being used to prevent/control the theft of a vehicle.

B. Proposed System

The main objective of our project is to secure a person who is under risk, since security is very important in day-to-day life for almost all the sectors in the world. The main concept of this design is the introduction of GSM and GPS Technologies into the embedded system. We use GSM, which is available in all parts of the world for transmitting specific template and GPS for location identification and FSR sensor to detect the force applied. Under risk condition, if a person taps his foot forcibly, it enables the microcontroller to send a template to the specified contacts via GSM. And the location of the person under risk can also be tracked using GPS.

II. PROPOSED SYSTEM ARCHITECTURE

A. Transmitter Section

This project is based on the security of a person under some kind of risk. Figure-1 shows the block diagram of transmission section. FSR sensor is used in this project to sense the applied force. PIC Microcontroller is used to control the overall activities. Whenever a person is in distress or under risk, he/she has to hit the ground forcibly, such that the analog information from the FSR is being converted into digital using ADC technique. PIC Microcontroller reads the digital information and when the information exceeds some predefined threshold value, a signal will be transferred to the RF Transceiver through Serial Peripheral Interface, which is nothing but the onboard communication protocol.

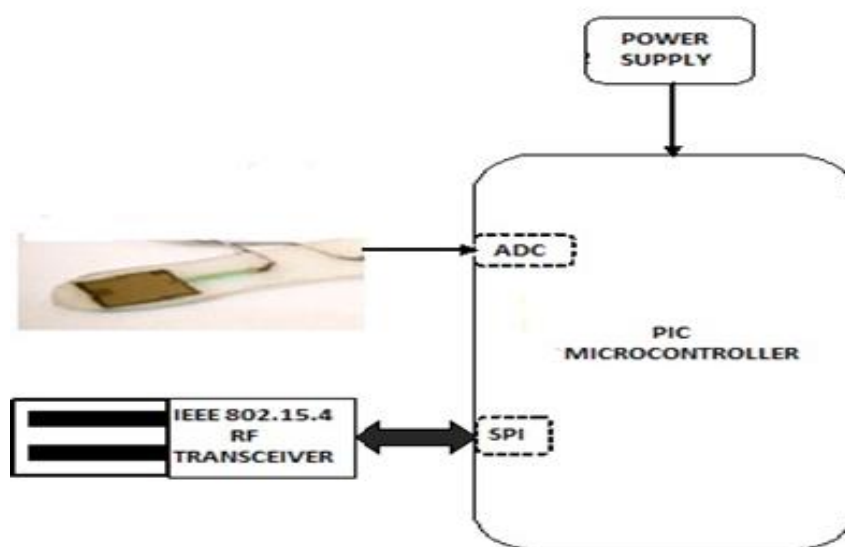


Figure-1: Block diagram of Transmission section

B. Receiver Section

Figure-2 shows the block diagram of receiver section. RF Transceiver at the receiver section receives the signal from the transmitter section. PIC Microcontroller processes this information and this processed information is sent to the user using GSM modem. GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services. The GSM modem interfaced to the PIC and it is controlled by AT commands. The GSM modem sends SMS to the predefined mobile number and intimates about the risky condition. And using the triangulation method, GPS module feeds the exact location in the form of latitude and longitude to the user's mobile i.e. Position of the person in the globe using GPS system will be sent to the respective person. Thus, the exact location of the person can be determined by this system and any person under risk can be rescued as soon as possible.

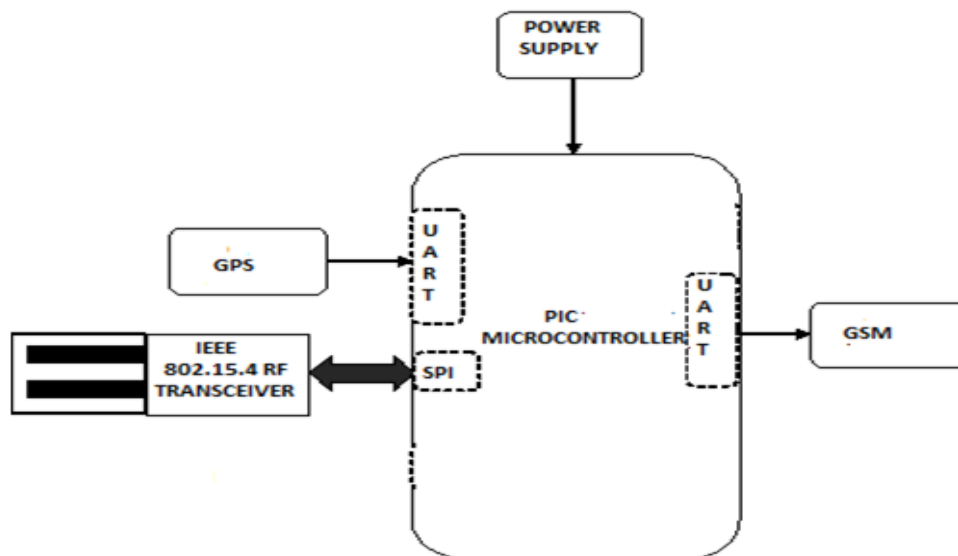


Figure-2: Block diagram of Receiver section

III. RELATED TECHNOLOGY

A. PIC18F4511 Controller

A microcontroller is a computer-on-a-chip, or a single-chip computer. Micro suggests that the device is small, and controller tells that the device might be used to control objects, processes, or events. **PIC microcontrollers** are based on advanced RISC architecture. RISC stands for Reduced Instruction Set Computing. In this architecture, the instruction set of hardware gets reduced which increases the execution rate (speed) of system. PIC microcontrollers follow Harvard architecture for internal data transfer. In Harvard architecture there are two separate memories for program and data. These two memories are accessed through different buses for data communication between memories and CPU core. This architecture improves the speed of system over Von Neumann architecture in which program and data are fetched from the same memory using the same bus. PIC18 series controllers are based on 16-bit instruction set.

B. FSR

A force sensing resistor is a Piezoresistivity conductive polymer, which changes resistance in a predictable manner following application of force to its surface. Figure-3 shows the structure of the FSR 406. It is normally supplied as a polymer sheet which has had the sensing film applied by screen printing. The sensing film consists of both electrically conducting and non-conducting particles suspended in matrix. The particle sizes are of the order of fraction of microns, and are formulated to reduce the temperature dependence, improve mechanical properties and increase surface durability. Applying a force to the surface of the sensing film causes particles to touch the conducting electrodes, changing the resistance of the film. FSRs are also known as "Pressure Sensing", "Force Sensitive Resistors", etc. Force Sensing Resistors (FSRs) are a type of resistor whose resistance changes when a force or pressure is applied. The resistance is inversely proportional to the force applied, i.e. the resistance decreases as the force gets increases.

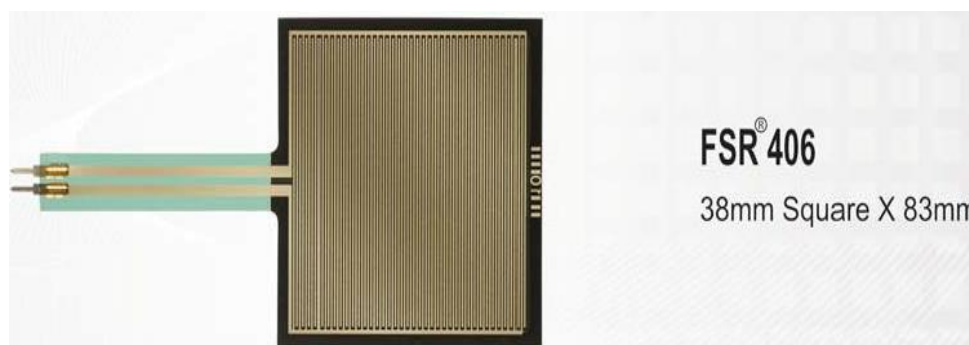


Figure-3: FSR 406

C. RF Transceiver

RF transceiver acts as transmitter as well as receiver and it is designed for low-power and low-voltage wireless applications and it has the frequency range as 2.4GHz. MIWI is being used as the wireless protocol in this project. The Microchip MiWi™ P2P Wireless Protocol is a variation of IEEE 802.15.4, using Microchip's MRF24J40MA 2.4 GHz transceiver and any Microchip 8, 16 or 32-bit microcontroller with a Inter Integrated Circuit (I2C). The protocol provides reliable direct wireless communication via an easy-to-use programming interface. It has a rich feature set that can be compiled in and out of the stack to meet a wide range of customer needs – while minimizing the stack footprint. Figure-4 shows the structure of the RF Transceiver.

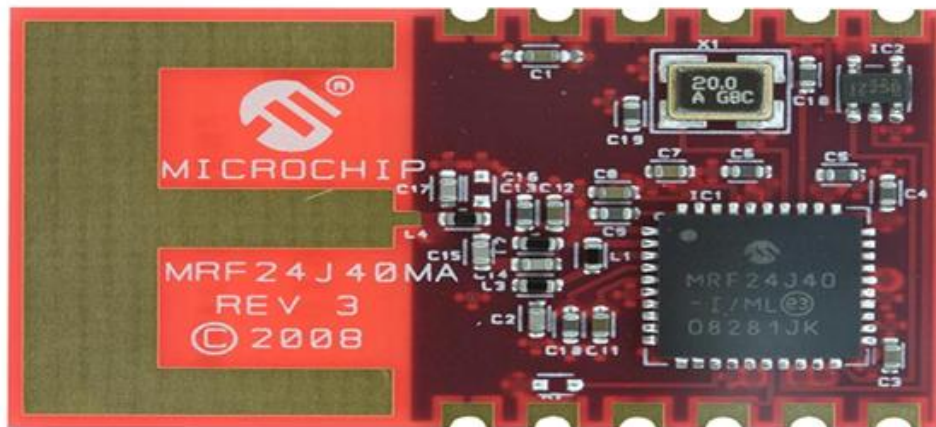


Figure-4: IEEE 802.15.4 RF Transceiver

D. GPS Technology

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver. The GPS is a location system based on a constellation of about 24 satellites orbiting the earth at altitudes of approximately 11,000 miles. GPS was developed by the United States Department of Defense (DOD), for its tremendous application as a military locating utility. The DOD's investment in GPS is immense. GPS has proven to be a useful tool in non-military mapping applications as well. As GPS units are becoming smaller and less expensive, there are an expanding number of applications for GPS. In transportation applications, GPS assists pilots and drivers in pinpointing their locations and avoiding collisions. Farmers can use GPS to guide equipment and control accurate distribution of fertilizers and other chemicals. Recreationally, GPS is used for providing accurate locations and as a navigation tool for hikers, hunters and boaters.

E. GSM Technology

GSM stands for Global System for Mobile Communication and is an open, digital cellular technology used for transmitting mobile voice and data services. The GSM standard is the most widely accepted standard and it is implemented globally. The GSM is a circuit-switched system that divides each 200 kHz channel into eight 25 kHz time-slots. GSM operates in the 900 MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. The GSM makes use of narrowband Time Division Multiple Access (TDMA) technique for transmitting signals. The GSM was developed using digital technology. It has an ability to carry 64 kbps to 120 Mbps of data rates. Presently GSM support more than one billion mobile subscribers in more than 210 countries throughout of the world. The GSM provides basic to advanced voice and data services including Roaming service. Roaming is the ability to use your GSM phone number in another GSM network. A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable.

IV. TEST AND IMPLEMENTATION

A. Software Testing

The MPLAB X IDE is the new graphical, integrated debugging tool set for all of Microchip's more than 800 8-bit, 16-bit and 32-bit MCUs and digital signal controllers, and memory devices. It includes a feature-rich editor, source-level debugger, project manager, software simulator, and supports Microchip's popular hardware tools, such as the MPLAB ICD 3 in-circuit debugger, PICKit™ 3, and MPLAB PM3 programmer. IC-PROG is windows based software to control a development programmer for PIC microcontroller. To operate the software, a basic knowledge about electronics and windows OS is necessary. In order for this software to operate you have to attach a programmer to your computer and set up the hardware and the software appropriately. IC-PROG has been designed as universal programming applications for all programmers. Figure-5 shows the successful compilation of transmitter and receiver coding.

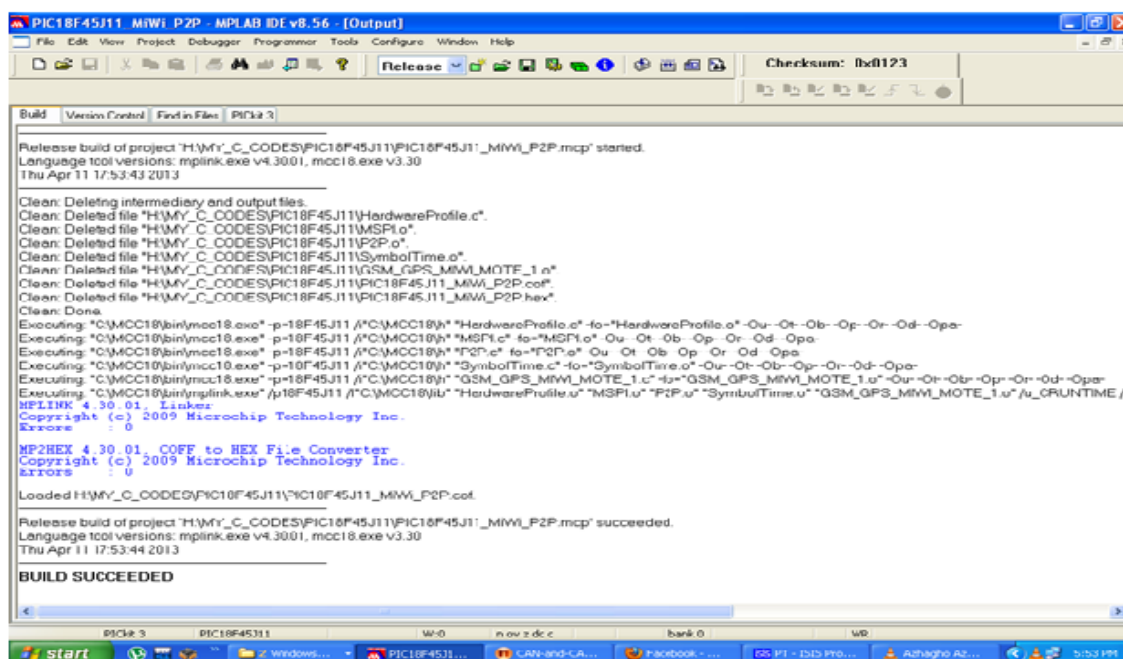


Figure-5: Compilation of Transmitter/Receiver coding

B. Hardware Implementation

It is composed of two sections. Figure-6 shows the snapshot of the Transmitter unit which is placed at the leg consists of Force Sensing Resistor which is interfaced with PIC Microcontroller. FSR is used to sense the force being applied.



Figure-6: Snapshot of the Transmitter

Whenever a person is in distress, he/she has to hit the sandal forcibly on the ground to activate the control unit. When the applied force exceeds the threshold level, the signal will be transmitted to the RF Transceiver through SPI.

Figure-7 shows the snapshot of the receiver unit which consists of GSM, GPS, PIC, and RF Transceiver. The receiver unit receives the signal from the leg unit and then the PIC Microcontroller processes this information and this processed information is sent to the user using GSM modem along with the location of the person under risk using GPS. Then the location of the person under risk by plotting the latitude and longitude values in the respective box in the Google map.

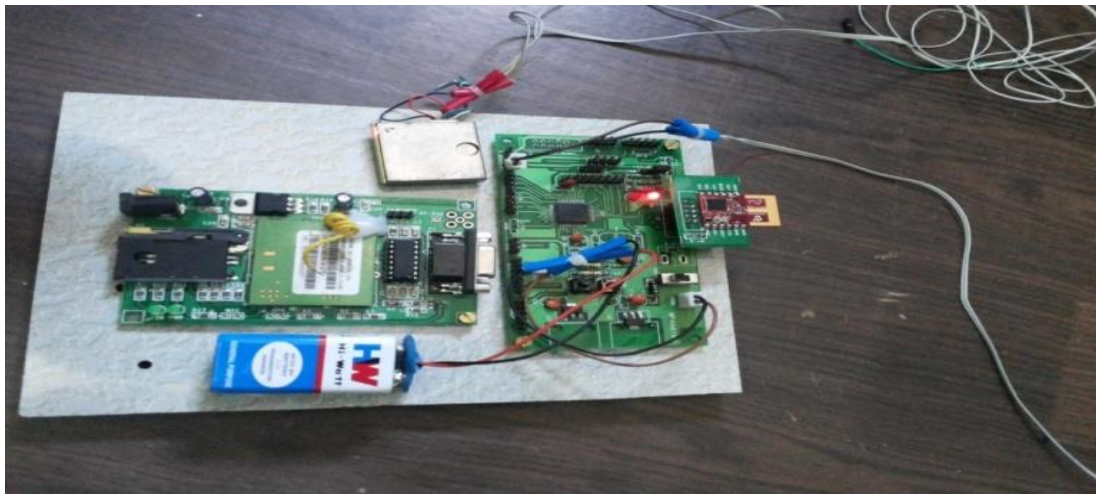


Figure-7: Snapshot of the Receiver

IV. CONCLUSION

Thus, we conclude by saying that our project based on self security alert system using wireless sensor network saves the life of a person, provides security as well as freedom to move on. With the use of wireless technology, an alert message can be sent to 'n' number of users under the risky condition. Ideally, this project can be more convenient and secure with the use of satellites modems instead of cell phone as tracking device as the system may fail when there is no network coverage. The hardware will be self contained and cannot be prone to electronic failure. Hence, we conclude that the required goals and objectives of this system have been achieved.

V. FUTURE ENHANCEMENTS

We have integrated FSR, GSM and GPS into the embedded system. The basic level of self security alert has been implemented and this system is extensible and more levels can be further developed by using Black box. This design can be made more enhanced in future to support camera, wireless video transmission and electric shock and this system can also be made compact in the future by employing it with chain, bracelet, wrist watches, etc.

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